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Summary

Electronic media, particularly television, have long been criticized for their potential impact on children. One area for concern is how early media exposure influences cognitive development and academic achievement. Heather Kirkorian, Ellen Wartella, and Daniel Anderson summarize the relevant research and provide suggestions for maximizing the positive effects of media and minimizing the negative effects.

One focus of the authors is the seemingly unique effect of television on children under age two. Although research clearly demonstrates that well-designed, age-appropriate, educational television can be beneficial to children of preschool age, studies on infants and toddlers suggest that these young children may better understand and learn from real-life experiences than they do from video. Moreover, some research suggests that exposure to television during the first few years of life may be associated with poorer cognitive development.

With respect to children over two, the authors emphasize the importance of content in mediating the effect of television on cognitive skills and academic achievement. Early exposure to age-appropriate programs designed around an educational curriculum is associated with cognitive and academic enhancement, whereas exposure to pure entertainment, and violent content in particular, is associated with poorer cognitive development and lower academic achievement.

The authors point out that producers and parents can take steps to maximize the positive effects of media and minimize the negative effects. They note that research on children's television viewing can inform guidelines for producers of children's media to enhance learning. Parents can select well-designed, age-appropriate programs and view the programs with their children to maximize the positive effects of educational media.

The authors' aim is to inform policymakers, educators, parents, and others who work with young children about the impact of media, particularly television, on preschool children, and what society can do to maximize the benefits and minimize the costs.

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Since television first appeared in the nation's living rooms in the middle of the twentieth century, observers have voiced recurrent concern over its impact on viewers, particularly children. In recent years, this concern has extended to other electronic screen media, including computers and video game consoles. Although researchers still have much to learn, they have provided information on the links between electronic media, especially television, and children's learning and cognitive skills. The message is clear: most (if not all) media effects must be considered in light of media content. With respect to development, what children watch is at least as important as, and probably more important than, how much they watch.

Until the 1980s, social science researchers had only an implicit theory of how viewers watched television.

In this article we review media research with an emphasis on cognitive skills and academic achievement in young children. We begin by arguing that by age three, children are active media users. We then discuss important aspects of child development that highlight the debate over whether children younger than two should be exposed to electronic media, emphasizing the apparent video deficit of infants and toddlers in which they learn better from real-life experiences than they do from video. Next we look at research on media effects in three areas: associations between media use and cognitive skills, particularly attention; experimental evidence for direct learning from educational media;

and associations between early media use and subsequent academic achievement. We close with some suggestions for both media producers and parents for enhancing and extending the potentially beneficial effects of electronic media use in children, particularly those who are of preschool age.

Children as Active Media Users

Until the 1980s, social science researchers had only an implicit theory of how viewers watched television. Analysts regarded television viewing, particularly by young children, as being cognitively passive and under the control of salient attention-eliciting features of the medium such as fast movement and sound effects. Jerome Singer formalized this theory, proposing that the "busyness" of television leads to a sensory bombardment that produces a series of orienting responses that interferes with cognition and reflection. As a result, children cannot process television content and therefore cannot learn from it.¹ Others proposed similar views, arguing that programs such as *Sesame Street* provided nothing that could be truly educational.²

Aletha Huston and John Wright proposed a somewhat different theory of attention to television, positing that the features of television that drive children's attention may change as a child ages. Specifically, they claimed that in infancy, perceptually salient features of television such as movement and sound effects drive attention. With age and experience, however, children are less influenced by perceptual salience and are able to pay greater attention to informative features such as dialogue and narrative.³

Around the same time, Daniel Anderson and Elizabeth Lorch created a complementary model of children's attention to television, drawing on evidence that television viewing is

Table 1. Selected Popular Television Programs and DVD Series for Young Children

TV programs	Description	Network
Barney & Friends	Evoking a preschool setting, Barney the dinosaur teaches songs and dances to young children. The show focuses heavily on pro-social themes of sharing, empathizing, helping others, and cooperating.	PBS
Blue's Clues	A human host encourages viewers at home to help solve a mystery with his dog friend, Blue. The show is often repetitive and encourages interactivity by asking viewers to find clues and solve puzzles.	Nickelodeon
Bob the Builder	Bob the Builder and his construction crew face building, renovation, and repair challenges. The series often focuses on identifying a problem and making a plan to solve the problem.	PBS
Dora the Explorer	Featuring a bilingual Latina girl as the lead, Dora and her friends go on quests and help others, encouraging viewers to help out through their own actions or by telling her what she needs to know. In addition to highlighting traditional educational content such as color and shapes, Dora teaches language by repeating words and phrases in English and Spanish.	PBS
Sesame Street	Combining puppetry, live action, and animation, this long-running series focuses on a wide range of topics including the alphabet, numbers, emotion management, conflict resolution, music, dance, and healthy lifestyles.	PBS
Teletubbies	Centering on four colorful characters, the Teletubbies speak in a baby-like language and learn through play. The Teletubbies have televisions in their stomachs that show clips of real children from around the world. This program is targeted at toddlers.	PBS
Thomas & Friends	Based on a book series, Thomas the Tank Engine and his engine friends learn to work hard and be cooperative with each other.	PBS
The Wiggles	Featuring a four-man singing group for children, episodes of The Wiggles include songs and skits focused on solving a problem. The Wiggles encourages children to sing songs and move their bodies to music.	Disney
DVD series	Description	Producer
Baby Einstein	Series content covers wide range of topics including music, art, language, poetry, and science. Targeted at children starting at one month.	Disney
Brainy Baby	Educational series highlighting range of subjects including alphabet, art, music, shapes, foreign languages, and right and left brain development. Targeted at children starting at nine months.	Brainy Baby Company
Sesame Beginnings	Features baby versions of the Muppets from Sesame Street. The focus is on encouraging interactions between child and caregivers. Targeted at children starting at six months.	Sesame Workshop

based on active cognition. They argued that attention in children at least as young as two is guided in large part by program content. For example, preschool children pay more attention to normal video clips than to those that have been edited to make them incomprehensible, for example by using foreign dubs of the video clips or randomizing the order of shots within the clips.⁴ Moreover, preschool-age children pay more attention to children's programs than to commercials even though commercials are more densely packed with formal features.⁵ Children learn strategies for watching television by using their knowledge of formal features to guide atten-

tion.⁶ Finally, to understand typical programs that use standard video montage such as cuts, pans, and zooms, children engage in a variety of inferential activities while viewing.⁷

Developmental Considerations

Although children are active viewers of television by preschool age, research suggests that this may not be true of infants and toddlers. In this section we summarize research on attention to, comprehension of, and learning from video by children under two.

Attention to Electronic Media

Until recently, research on media effects

did not focus on infants and toddlers. Early studies reported that children younger than two paid little attention to television, perhaps because little television was produced for them.⁸ The early 1990s, however, saw a virtual explosion in the production of television

Research suggests that children do not comprehend the symbolic nature of television until they reach the preschool years.

programs and videos designed for infants and toddlers, and some research now suggests that infants and toddlers pay close attention to these videos.⁹ The increase in infant-directed media products has led to debate over whether infants and toddlers should be exposed to electronic media. (See table 1 for a description of some popular media products for young children.)

Although the underlying mechanisms driving attention to video appear to be the same in adults and infants as young as three months, some research has found differences in the ways in which younger and older viewers watch professionally produced video.¹⁰ For example, one study observed patterns of eye movements in one-year-olds, four-year-olds, and adults while they watched *Sesame Street* and found systematic differences between infants and older viewers. Infants' visual fixations, for example, were more variable and less sensitive to changes in content.¹¹ In another experiment, children aged six, twelve, eighteen, and twenty-four months watched normal and distorted segments of *Teletubbies*, a program designed for viewers in this age

range.¹² In one distorted video, shots were randomly ordered; in the other, utterances were reversed to produce backwards speech. The experiment found that although older children (eighteen and twenty-four months) looked for longer periods at the normal video segment than at the distorted segments, younger children (six and twelve months) did not appear to discriminate between the two. These findings suggest that children under eighteen months may not understand, and thus learn from, television in the same way as do older children. In particular, they may be inattentive to dialogue and may fail to integrate comprehension across successive shots in filmic montage.

Perception of Video

One area of cognitive development influencing children's ability to learn from television is the perception of video itself. Some research suggests that children do not begin to discriminate between television and real-life events until the early preschool years. For example, Leona Jaglom and Howard Gardner reported qualitative observations of three children from age two to five. They noted that at age two, the children recognized that the television world was contained within the television set but not until they reached age three or four did they realize that the television world could not affect them—that, for example, television characters could not enter their bedrooms. The authors concluded that sometime between ages two and three, children develop an understanding of the representational nature of video.¹³

In a similar vein, John Flavell and several colleagues conducted a series of experiments with preschool-age children to investigate the distinction they made between real objects and those represented on video. Younger children were less likely to correctly answer

questions regarding the uses of objects on television. For example, three- and four-year-old children saw a video image of a bowl of popcorn and were asked if the popcorn would fall out of the bowl when the television set was turned upside down. The four-year-olds recognized that televised images represent real objects while three-year-olds failed to discriminate between televised images and real objects, claiming that the popcorn would fall out of the bowl if the television was turned upside down.¹⁴

Other research focusing on children's ability to discriminate between televised programs and commercials has generally demonstrated that children younger than five cannot consistently make that distinction.¹⁵ Even when young children correctly label programs and commercials, they may still think that the commercial is part of or connected to the program.¹⁶ Moreover, although children may be able to identify commercials based on perceptual cues by age five, their ability to recognize the persuasive intent and inherent bias in advertising does not appear to develop until age seven or eight.¹⁷

Together this research suggests that children do not comprehend the symbolic nature of television until they reach the preschool years; evidence of comprehending and learning from television at younger ages than about two-and-a-half is meager. And it may take several more years before children are able to make more specific discriminations with respect to program content.

Learning from Electronic Media

Many infant-directed media products make explicit claims about their educational value; others, with titles such as *Baby Einstein*, keep their claims implicit. But analysts know little about the extent to which children two

years and younger learn from commercially produced television programs. Experiments on learning from video have repeatedly found that infants and toddlers learn better from real-life experiences than from video. This so-called video deficit disappears by about age three, when learning from video becomes robust.¹⁸

Support for the video deficit hypothesis comes from several lines of research. Studies of language learning have demonstrated that children aged two and older can learn vocabulary from television.¹⁹ Unlike older children, however, infants and toddlers are less likely to learn from video. One experiment found that children younger than two learned vocabulary better from real-life experiences than from equivalent video presentations.²⁰ Other experimental research demonstrates that television models are less effective than live ones in preserving discrimination of foreign phonemes (speech sounds) in infants.²¹

Additional support for the video deficit hypothesis comes from studies examining infants' and toddlers' ability to imitate specific actions, such as an adult demonstrating actions with a puppet. In an experiment comparing toddlers' imitation of live and mediated (that is, videotaped) models, Rachel Barr and Harlene Hayne reported that twelve-, fifteen-, and eighteen-month-olds were more likely to perform a behavior after viewing unmediated, live models than after viewing either the video model or no model. Only the oldest age group was more likely to perform the behavior after seeing the video model than the control group after seeing no modeled behavior.²² A more recent experiment made similar findings for children at twenty-four and thirty months.²³ It is clear that, unlike infants and toddlers, preschool-age children can readily imitate behaviors seen on video.²⁴

Another line of research relevant to infants' and toddlers' ability to transfer from video to real-world problems involves object-retrieval tasks. In these experiments, the child either sees a toy hidden in an adjacent room through a window or watches the toy being hidden on television. In a study of children aged two and two-and-a-half, Georgine Troseth and Judy DeLoache reported that both age groups were able to find the toy on every trial when the hiding event was seen through a window but less often when the event was watched on television, particularly for the younger participants.²⁵ Kelly Schmitt and Daniel Anderson reported similar findings with overall performance at chance levels (25 percent) for children aged two and about 50 percent for children aged two-and-a-half in the television task but nearly perfect at both ages for the window task. Three-year-olds did well on both tasks.²⁶ Marie Schmidt, Alisha Crawley-Davis, and Daniel Anderson attempted to minimize the influence of perceptual cues and simplify the task in two experiments. In the first, a sticker was hidden underneath a cutout on a felt-board that had the same dimensions as the television screen. In the second, an experimenter simply told the child, either live or on closed-circuit television, where the object was hidden. Performance of two-year-olds in both tasks was still at chance levels in the television conditions.²⁷ Georgine Troseth and Judy DeLoache attributed this deficit to a poor understanding of symbolic representations or to prior expectations about television as "unreal." Recent work by Troseth shows that if toddlers have interactive experiences with television—if, for example, they converse with an experimenter via closed-circuit video—the video deficit in the object-retrieval task can be overcome.²⁸

Overall, the bulk of the research supports a video deficit for learning by infants and

toddlers even though it can be overcome by an interactive relationship. Researchers have not yet demonstrated any learning, or lack of it, from commercial baby videos. One recent study evaluated the effect of a series of baby videos designed to foster parent-child interactions. Compared with parents who watched a comparison series (*Baby Einstein*), parents who watched videos from the *Sesame Beginnings* series showed more engaged interactions with their twelve- to twenty-one-month-old children if they had covieved the videos at home on multiple occasions.²⁹ Although there is as yet no evidence that babies learn anything from baby videos, apparently covieving parents can.

To our knowledge no research has yet examined computer and interactive game use in infants and toddlers, although these products are now being developed for children as young as six months of age and some parents report that their infants and toddlers use these media regularly. Based on a recent survey of parents, the Kaiser Family Foundation estimated that 61 percent of children under age two use screen media (television, videos, DVDs) on a typical day and 43 percent of infants and toddlers watch television every day.³⁰ Given a relative dearth of empirical research on infants and toddlers and a dispute over whether they even comprehend screen media, for the remainder of this article we will focus on educational media designed for preschoolers and older children. Research is urgently needed, however, to determine how media influence infants and toddlers.

Media Effects on Attention and Other Cognitive Skills

Among their other charges, critics have often accused television of being a negative influence on the development of children's cognitive skills. Much of the debate about the

effect of television on cognition concerns the development of attention. The most common hypothesis has been that frequent changes in scenes and content disrupt young children's ability to sustain attention.³¹ One reanalysis of longitudinal data collected during the 1980s found a small correlation between early television exposure at ages one and three years and subsequent symptoms of attention problems at age seven.³² Findings from studies since then have been mixed.³³

One possible mediating factor in the link between early television viewing and attention skills is program content. Most correlational studies do not measure the types of programs to which children are exposed, making it impossible to draw any conclusions regarding content effects. However, a recent correlational study suggested that content is an important mediator of the relation between exposure to television before age three and subsequent attentional problems. Specifically, early exposure to violent and non-educational entertainment programming was positively associated with later symptoms of attention deficit but exposure to educational television was not related to attentional problems.³⁴

One early study of the effects of television on behavior in preschoolers experimentally varied the type of content children viewed. The study compared preschoolers who were exposed to prosocial programs (*Mister Rogers' Neighborhood*), neutral films, and violent cartoons (*Batman*, *Superman*).³⁵ Children were observed first for a baseline period of three weeks, then for a four-week television viewing period, and finally for two weeks after the viewing period. Findings from this study suggest that the link between television viewing and children's attentional skills is mediated by content. Children who viewed the violent cartoons showed decreases in mea-

asures of self-regulation, whereas those who viewed the prosocial programs showed higher levels of task persistence, rule obedience, and tolerance of delay relative to baseline measures and to children in the neutral viewing condition. It is important to note that the three categories of programs likely differed not only in content but with respect to formal features such as format (animation versus live-action) and pace. It is difficult within the context of this study to isolate the links between content and self-regulatory skills, but the findings clearly indicate that television as a medium does not have an indiscriminate negative effect on attentional skills. In fact, several experiments have found that television can teach specific attention skills and strategies.³⁶

Educational television programs, those designed around a curriculum with a specific goal to communicate academic or social skills, teach their intended lessons.

Many allegations regarding the effect of television on children's attention skills focus on the fast pace of programs such as *Sesame Street*.³⁷ The only study to experimentally vary the pace of a television program observed preschoolers during tasks of perseverance after the children either viewed an edited version of *Sesame Street*, composed of either particularly fast-paced segments or particularly slow-paced segments, or read books with parents. Analysts found no group differences in measures of distractibility or impulsiveness following either reading or

television viewing.³⁸ This finding suggests that there is no immediate link between program pacing and attentional skills. Nonetheless, longitudinal research manipulating program content is needed to experimentally investigate the causal effect of television on attention in preschoolers.

Discussions of computer use and video games have been more optimistic, with the relevant research seeming to support a link between both and cognition. The research generally focuses on cognitive skills other than attention. One study, for instance, conducted an experiment with fifth graders to investigate the effects of video game experience on spatial skills in children. Subjects were randomly assigned to an experimental group that played a spatial game, such as navigating a marble along tracks through space, or a control group that played a computerized word game that was not spatial. Although the study found no between-group differences on pre-test measures of spatial skill, it found significantly higher post-test scores for the spatial video game group than for the control group.³⁹ Similar results have been reported by others.⁴⁰

Overall, the research suggests that electronic media might have an effect on attention skills. Television, especially when viewed by children younger than age two, may have a negative effect on attention development, though the evidence is relatively weak. Concern over television exposure before age two has been echoed in research on cognitive development more generally.⁴¹ Content appears to be an important mediator, and specific television content has been linked to attention skills. Studies of interactive media have found that video game play may enhance spatial cognition, but research is lacking on other cognitive skills, particularly attention development.

Learning from Educational Media

Educational television programs, those designed around a curriculum with a specific goal to communicate academic or social skills, teach their intended lessons. But because most research assessing the effectiveness of educational curricula is proprietary or not published in archival sources, most program evaluations go unseen by the general public. Nevertheless, reviews of this research demonstrate the effectiveness, both short-term and long-term, of curriculum-based

Preschoolers who view Sesame Street have higher levels of school readiness than those who do not.

programming for children in areas as diverse as literacy, mathematics, science, and social skills.⁴² Academics have also published research evaluating the effectiveness of educational programs. We present examples of both correlational and experimental evaluative studies.

Blue's Clues is a television program focusing on social and cognitive problem-solving skills in preschoolers. In a two-year program evaluation, Jennings Bryant and others followed preschoolers who were regular viewers of the show and preschoolers who were not because the program did not air in their town of residence. The two groups of children did not differ on measures of problem solving and flexible thinking at the start of the study. At the end of the two-year observation period, however, regular viewers of *Blue's Clues* outperformed their non-viewing peers in many measures and were more successful and systematic in their problem solutions.

Solving the problems required careful planning, a trait frequently modeled and described in the program.⁴³ In an experimental study, preschool-age children were randomly assigned to watch one episode of *Blue's Clues*, or the same episode five times, or one episode of a different program. Not surprisingly, children who viewed the *Blue's Clues* program showed better comprehension of the specific information presented in the show, and children who watched the program five times showed better comprehension than those who saw it only once. Moreover, *Blue's Clues* viewers scored higher than non-viewers on problem-solving tasks different from those directly presented in the program, particularly when they viewed the program repeatedly.⁴⁴ Together these studies demonstrate immediate and potentially long-lasting effects of *Blue's Clues* on problem-solving skills, especially for regular viewers of the program.

Some television programs designed for young children focus on a variety of academic and social skills to help prepare children for entering school. One such program is *Sesame Street*, which has been by far the most studied children's program, probably because of Sesame Workshop's commitment to research, the program's longevity and popularity, and its long history of both criticism and praise. Correlational research demonstrates a positive association between early exposure to *Sesame Street* and school readiness.⁴⁵ That is, after analysts statistically control for a range of other factors known to affect school readiness, they find that preschoolers who view *Sesame Street* have higher levels of school readiness than those who do not. Nationally, there is some evidence for an increase in school readiness among preschoolers in recent years.⁴⁶ One plausible explanation for this trend may be increased early exposure to television, particularly educational programs for young children,

though as yet evidence is insufficient to draw solid conclusions. Although media may have contributed to the trend, many other explanations, such as increases in preschool enrollment, also are plausible.⁴⁷

Other forms of electronic media also have been used for education. For instance, some professionally produced, curriculum-based Internet websites for preschoolers are associated with television shows such as *Sesame Street* or *Dora the Explorer*, though no public domain research is available on the effect of these websites. Researchers have conducted studies on the use of educational software at home. For example, one experiment reported significant gains in the effectiveness of educational software when children were allowed to use the software at home as well as in school.⁴⁸ Similar benefits have been reported by other researchers.⁴⁹

To summarize, it is clear that children can learn from educational media. Television programs designed with a specific goal to teach academic or social skills can be effective with potentially long-lasting effects. Although scarce, research on interactive media software suggests similar results. We turn now to a discussion of associations between overall media use in early childhood and subsequent measures of overall achievement.

Early Media Use and Academic Achievement

Among the most common criticisms of children's media use is that it displaces other activities believed to be more beneficial such as outdoor play, homework, and leisure reading. Historically, however, television viewing has largely displaced other entertainment media such as comic books, radio, and cinema.⁵⁰ For the most part, television viewing does not appear to displace more educationally valu-

able activities, except perhaps in the case of children and youth with extraordinarily high television exposure or of early school-age children learning to read, typically in first and second grade.⁵¹ Potential displacement effects of relatively new, interactive media are less clear because users can access multiple media platforms simultaneously, using a computer, for example, while watching television.⁵²

Many studies of the effect of television viewing on academic achievement examine correlations between some measure of television exposure and some contemporaneous measure of achievement.⁵³ In these studies, correlations are often negative, indicating greater achievement with lower exposure to television, but the associations are also often quite small. Moreover, findings of correlational studies can be difficult to interpret. It may be that television viewing lowers academic achievement, but it is equally plausible that academically challenged children are more drawn to television as a leisure-time activity. Moreover, some third variable that has not been accounted for may explain both television exposure and achievement. In the case of television viewing, for example, children from lower-income homes tend to watch more television and also to score lower on measures of academic achievement than do their higher-income counterparts.⁵⁴ In this example, both television exposure and academic achievement may be the result of family income. In fact, when correlational studies take into account other important factors, they often fail to find significant associations between television exposure and academic achievement in children.

Detailed analyses of the relation between television exposure and academic achievement suggest that this relation is not straightforward. For example, a meta-analysis of twenty-three studies reported that the aver-

age correlation between total viewing time and academic achievement was only $-.05$, a tiny association. More accurately described, the relation was what social scientists call curvilinear. That is, in moderation (one to two hours a day), television viewing was positively associated with academic achievement, but higher rates of television viewing were associated with decreasing achievement.⁵⁵ Other studies have found a similar pattern.⁵⁶

One important factor in the association between television viewing and academic achievement may be the age of the viewer. The optimal amount of television exposure may vary with age, possibly as a function of the types of programs viewed at different ages.⁵⁷ Few studies have directly investigated the association between achievement and television viewing in infants and toddlers. In one study, however, viewing before age three was negatively related to later academic achievement whereas viewing at three years and beyond was positively related to subsequent achievement.⁵⁸

It is also important to note that most of the studies mentioned thus far did not distinguish between the types of content viewed. The lack of a straightforward association between television exposure and academic achievement may be at least partially mediated by the content of the programs viewed. For instance, although one study reported a generally curvilinear relation with highest achievement for children watching one to two hours a day, these moderate viewers were also more likely to report watching educational programming whereas heavier viewers were more likely to report entertainment viewing.⁵⁹ Indeed, several more recent studies have found that achievement is linked to early exposure to specifically educational television programming.

One of the most extensive studies of this kind reported that viewing educational programming at age five was positively associated with high school grades in English, math, and science. Early exposure to educational programming was also positively linked with a host of other factors such as leisure time reading and involvement in extracurricular activities.⁶⁰ In another longitudinal study, the effect of television exposure between six and thirty months of age depended on the content viewed. For example, early exposure to programs such as *Blue's Clues* and *Dora the Explorer* was positively linked with subsequent vocabulary and expressive language whereas viewing *Teletubbies* was negatively linked with performance on these measures.⁶¹ On its face, these findings contradict results indicating little language learning from video in children under two. It is possible, however, that the findings are attributable not to learning from programs but rather to self-selection such that children who have well-developing language skills prefer to watch different programs than their more slowly developing peers. Given the correlational nature of this study, it is impossible to know for certain what produced these findings.

Although watching educational programs can have academic and social benefits, watching other types of content can have drastically different results. For instance, longitudinal correlational research has demonstrated a negative association between early exposure to violent video content and academic achievement.⁶²

Not all non-educational television programs have explicitly negative content such as violence, but research on the links between academic achievement and general entertainment content is less clear. Although children can learn spontaneously from entertainment

content, some longitudinal studies report negative associations between academic achievement and viewing entertainment (as opposed to educational) media.⁶³ Specific information learned spontaneously from viewing entertainment does not appear to have the same cumulative long-term benefit as viewing curriculum-based educational programming.

Educational programs are positively associated with overall measures of achievement and with potentially long-lasting effects, while purely entertainment content, particularly violent content, is negatively associated with academic achievement.

With respect to interactive media such as video games and the Internet, findings are mixed, almost entirely correlational (allowing no conclusive cause-effect associations), and seldom conducted with young children. Although one study reported a negative association between video game use and academic achievement in adolescents, others report a positive association between achievement and computer and Internet use at home.⁶⁴ Though these few studies may suggest that video games are negatively linked with achievement whereas computers and Internet are positively linked with achievement, additional research is needed to systematically investigate this potential difference in outcome.

To summarize, when studies control for important confounding variables such as income and parent education, they often fail to find significant linear relations between television viewing and subsequent achievement. In fact, the association appears to be curvilinear, with achievement increasing to a peak at low levels of television viewing (one to two hours a day), and then declining with heavier viewing. That

To maximize the cognitive resources available to children to process educational content, one study suggests that producers integrate narrative and educational content as much as possible.

said, the most important mediator appears to be content of the programs viewed. Educational programs are positively associated with overall measures of achievement and with potentially long-lasting effects, while purely entertainment content, particularly violent content, is negatively associated with academic achievement. Age may also be an important mediator. Too few studies have been conducted with interactive media such as video games and computers to examine content effects systematically. Nonetheless, as noted in the previous section, software with an educational curriculum can have a positive influence on learning.

Production Techniques to Maximize Educational Benefits of Electronic Media

Producers of children's educational media can do several things to maximize the poten-

tial benefits to children. In this section we briefly discuss a few important mediators of the effectiveness of educational media.

Attention

Children cannot learn from educational messages to which they do not pay attention. Moreover, viewers learn more from television programs when they can pay sustained, unbroken attention.⁶⁵ Researchers have identified several means of maximizing children's attention to a program, some having to do with program content, others with formal features such as camera techniques and sound effects. As noted, one way to increase attention to a program is to maximize comprehensibility of the content, a topic we discuss in the next section.⁶⁶

At least by the preschool years, children use formal features of media—those characteristics that can be described with minimal reference to content—to guide attention. For example, cuts between shots, camera pans, and sound effects are considered to be formal features. One study found that formal features differ in the extent to which they elicit, maintain, terminate, and suppress preschool children's looks at the television. For example, child voices are likely to elicit looks from inattentive viewers whereas adult male voices are likely to suppress looks. The authors of the study interpreted their findings as demonstrating learned associations between formal features and types of content.⁶⁷ Children, for instance, often associate child voices with child-directed programming and adult male voices with content for adults. The attention-directing effect of formal features may thus change with age and experience, consistent with Huston and Wright's theory.⁶⁸ Such theories generate some interest in understanding how infants and toddlers respond to formal

features, though the only such study to date concluded that infants, toddlers, and older children responded similarly to a few visual formal features.⁶⁹ That is, the same features appear to elicit and maintain attention in all young viewers from infancy at least through the preschool years. Although viewers of all ages respond to formal features, Huston and Wright's theory predicts that content becomes increasingly important with age and formal features consequently less important except insofar as they are used to help process content. Moreover, the finding that attention in children under age two is driven partly by formal features does not necessarily mean that they comprehend video. It is more likely that such young children respond automatically to the saliency and unfamiliarity of formal features.

Comprehension

Just as children cannot understand an educational message to which they do not pay attention, they cannot learn from content that they do not understand. Shalom Fisch proposed what he called the capacity model of children's comprehension of television programs based on the limited cognitive resources people have available for processing information at any given moment.⁷⁰ Fisch makes a distinction between a program's narrative content—its story—and its educational content—its informative messages—and emphasizes the potential competition between the two types of content for the cognitive resources needed to process the program. To maximize the cognitive resources available to children to process educational content, Fisch suggests that producers integrate narrative and educational content as much as possible, making the educational message a central part of the ongoing story. For example, characters may have to solve a particular problem before advancing to the

next chapter in the story. In this way, narrative and educational content can capitalize on the same resources rather than compete for them. Although Fisch's presentation of the capacity model focused on educational television in particular, it can easily be applied to educational, interactive media as well.

Repetition

One reason why media can be such a powerful educational tool is that content can be easily and cheaply repeated. Literal repetition of episodes can enhance comprehension and subsequent learning. We have already noted the experimental study comparing preschoolers who watched one episode of *Blue's Clues* with those who watched the same episode once a day on five consecutive days. In that study, attention to the episode remained high and relatively constant over the course of five presentations while comprehension for program content increased with repeated exposure to the episode. Children also increasingly interacted with the content (in terms of audience participation) as the episode was repeated.⁷¹ Similar benefits of literal repetition have been reported in other studies.⁷² Moreover, the *Blue's Clues* experiment found that transfer of learning from the specific examples presented in the program to different problems with similar solutions increased as a function of program repetition.

Viewer Characteristics

Some studies of media effects suggest that a variety of viewer characteristics, including but not limited to intelligence, socioeconomic status, and gender, can mediate the effects of media on learning and academic achievement. To the extent that producers of children's media can take these characteristics into account during program design and production, they may enhance educational value. For example,

several correlational studies suggest that the negative impact of heavy television viewing on academic achievement may be stronger for girls or for individuals with higher intelligence.⁷³ Other studies suggest that television viewing may have differential effects on children from different socioeconomic groups. Specifically, television viewing is associated with higher achievement in children from lower-income homes and lower achievement in children from higher-income homes.⁷⁴ A longitudinal study that separately analyzed different content types found that the positive association between exposure to educational programs at age five and later achievement was significantly stronger for boys while the negative association between violent content and later achievement was stronger for girls. The authors interpreted this finding in the context of socialization. For example, because socialization of girls generally places more emphasis on academics, early exposure to educational programs may help boys become relatively more prepared for school.⁷⁵ Although these studies are often correlational and rarely conducted for the express purpose of investigating individual differences such as race or gender, they highlight some possible mediators of the effects of media on children.

Transfer of Learning

Direct learning of specific information from educational media is certainly useful, but a goal of most (if not all) educational initiatives is to empower children to apply what they have learned to real-life problems. Thus children must transfer to the real world what they learn from the media context (for example a television program set in a fantasy environment). Researchers now know relatively little about transfer of learning in young children, particularly with respect to television and interactive media, though some evidence suggests that even preschoolers can

transfer video information to real-life problems.⁷⁶ In a discussion of ideal conditions for transfer from television based on transfer of learning and analogical reasoning in children more generally, Fisch argues that transfer can be maximized not only by repeating the educational messages in the course of the episode but also by varying the contexts surrounding each presentation. He suggests that presenting the same lesson, such as a specific problem-solving strategy, several times using different types of examples can increase the flexibility of a child's mental representation of that strategy, thus enhancing the child's ability to accurately select and apply it in different real-life situations.⁷⁷

Parent Coviewing and Mediation

Just as media producers can increase the educational value of electronic media, so parents and other caregivers can also play an important role in increasing the effectiveness of educational media. Coviewing adults, for example, can enhance the effectiveness of educational programming by drawing attention to the most important aspects of the program and by extending lessons presented in the program. Some studies suggest that coviewing with a parent or other adult may increase a child's learning from educational television, particularly when the coviewer actively mediates by explicitly drawing attention to the program and by asking and answering questions.⁷⁸ Although some studies fail to find a benefit of adult coviewing or mediation, to our knowledge no evidence suggests a negative link between such parent involvement and learning from television. With respect to interactive media, findings are mixed. Although learning from educational software may be enhanced when an adult provides feedback or extends the lessons, it seems that children still need to be free to control the interactive experience themselves to maintain

interest in the activity.⁷⁹ Taken together, adult coviewing and mediation are most likely to have a positive effect on learning from educational media.

Educational Media in Schools

Although most research on electronic media focuses on use at home, some initiatives are evaluating the use of educational media in the classroom. Efforts have been made to create school curricula that integrate educational television programs, and a massive set of evaluations of such initiatives is now under way.⁸⁰ Ready to Learn, a public broadcasting initiative to enhance school readiness through educational television programs and online resources, offered workshops for parents and educators showing how to extend lessons from television programs through practice and repetition. A five-year evaluation of Ready to Learn found a modest but positive link between the workshops and the time adults spent coviewing PBS programs and reading books that extended lessons in the programs.⁸¹ Although analysts found no evidence that children's language and cognitive abilities benefited from the coviewing, the findings nevertheless hold some promise. The apparent benefits of adult mediation may provide a new area for extending the lessons of educational media.

Conclusions

Many studies have linked media use with cognitive skill development and academic achievement, with most thorough studies strongly suggesting that content is the most important mediating factor in that relation. Although the finding is particularly true for television, it is likely to be important for interactive media as well. There is strong evidence that children older than two learn from educational media, and there is moderate evidence that exposure to educational

television during the preschool years is positively linked with various measures of academic achievement even ten years later. Moderate evidence also suggests that early exposure to purely entertainment content, and media violence in particular, is negatively associated with cognitive skills and academic achievement. Research findings regarding the benefits associated with exposure to high-quality, age-appropriate, educational media offer producers of child-directed media an important opportunity to capitalize on the time that children older than two spend using these media. In fact, both producers and parents can take steps to maximize the positive effects of media and minimize negative ones. Research should guide the production of programs that foster learning and transfer. Moderate evidence suggests that parents can also maximize the benefits of media by selecting age-appropriate, educational programs and coviewing with their children.

Our review of media effects research is based largely on studies of young children of preschool age and older. Substantially less research is available on media exposure in children younger than two, and what little there is strongly suggests that learning from media by infants and toddlers may be different than it is for older children. Children under two suffer from a video deficit such that they learn substantially less from video than from comparable real-life experiences. Moreover, weak but nonetheless worrying evidence suggests a negative association between exposure to television younger than age two and later cognitive development. Given the dramatic increase in media now being produced for infants and toddlers, it has become particularly important to understand the effect of media during the first few years of life.

Taken together, the research indicates that electronic media are powerful influences on the lives of contemporary children. With advances in technology such as larger screens that provide images in high definition, three-dimensional surround sound, and greater possibilities for interaction, the power of media will likely only increase for the foresee-

able future. The influences can be both for good and for ill. Researchers are beginning to understand which aspects of media should be reduced and which enhanced, but further research is required. Ultimately, however, the question is whether society has the ability and will to enhance the positive aspects of media and reduce the negative.

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